

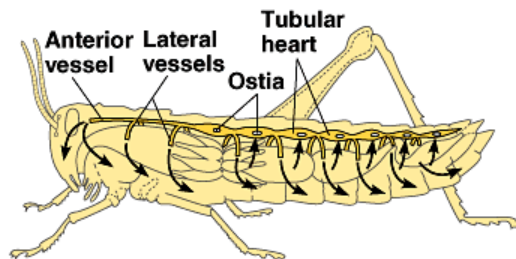
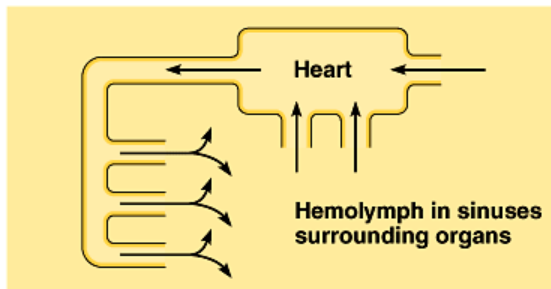
Cardiovascular and Respiratory Systems



- Chapter 42
 - *Circulation and Gas Exchange*

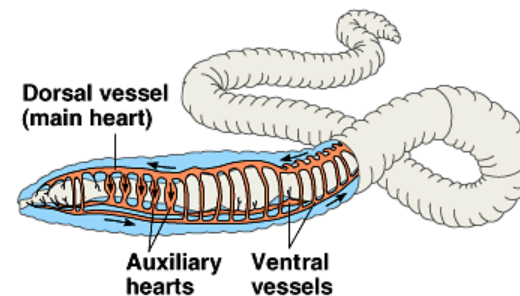
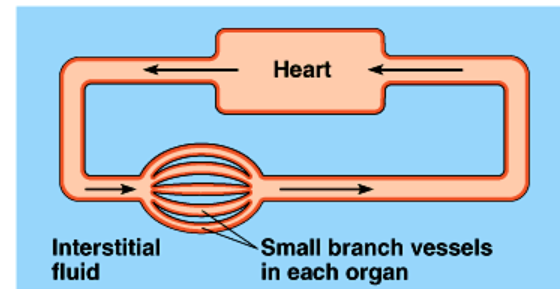
Circulation system evolution

- Gastrovascular cavity (cnidarians, flatworms) – aids in digestion and distribution of substances throughout the body
- Open circulatory: hemolymph (blood & interstitial fluid), sinuses (spaces surrounding organs)
- Closed circulatory: blood confined to vessels
- Cardiovascular system: heart (atria/ventricles), blood vessels (arteries, arterioles, capillary beds, venules, veins), blood (circulatory fluid)



(a) Open circulatory system

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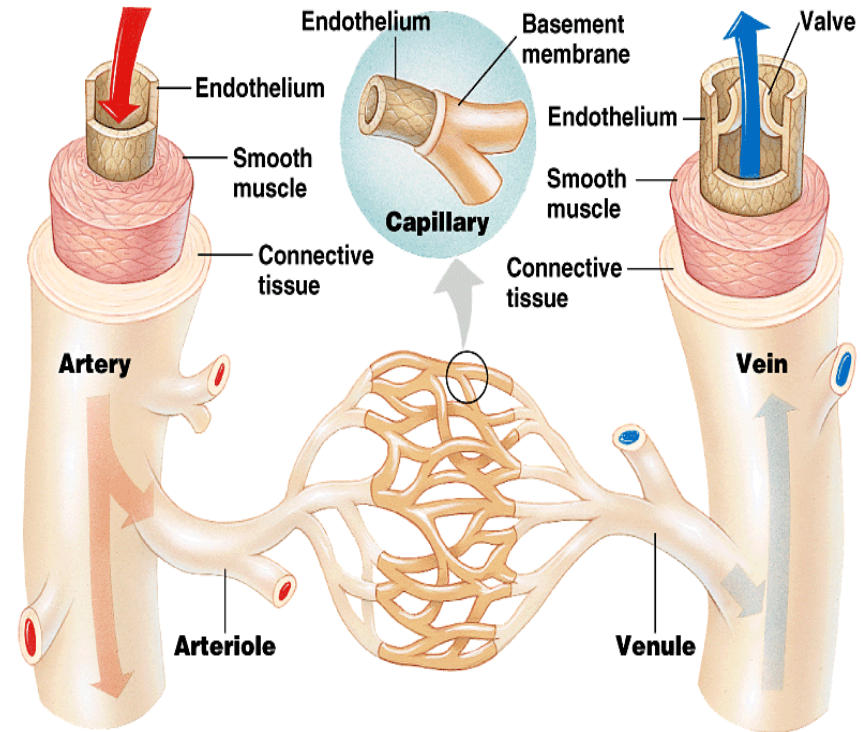
(b) Closed circulatory system

Circulatory System

- Function: transport materials to and from cells
 - Heart Anatomy:
 - Contains chambers: atria and ventricles
 - Valves separate the 2 chambers and another valve separates the ventricle from the artery as blood leaves the heart
 - Heart sounds occur when valves close – lub dup
 - Chordae tendineae = strings of tissue that hold the flaps of the valves in place
 - 3 layers: epicardium, myocardium, and endocardium
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Circulatory Anatomy: Blood vessels

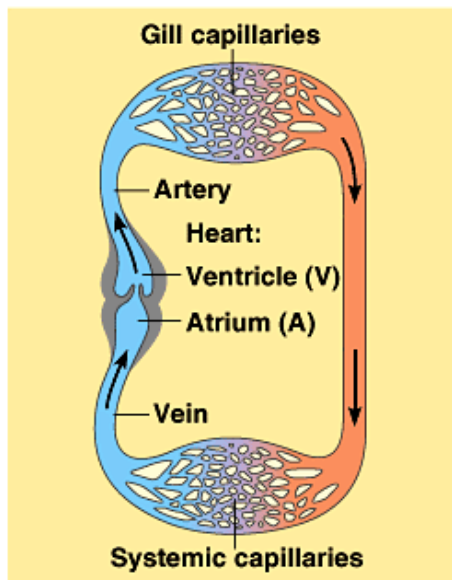
- Arteries: thick connective tissue; thick smooth muscle; no valves
- Arterioles: small branches of arteries
- Capillaries: one cell layer thick
- Venules: small branches of veins
- Veins: thin connective tissue; thin smooth muscle; valves



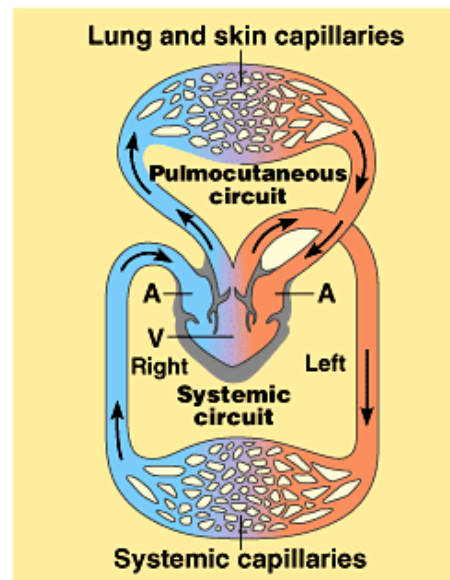
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Circulation system evolution

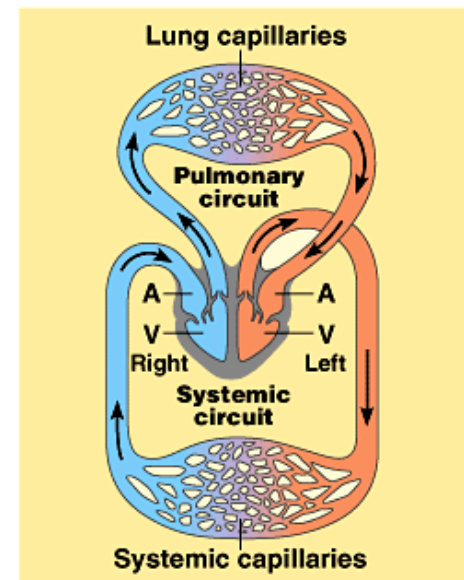
- Fish: 2-chambered heart; single circuit of blood flow
- Amphibians/Reptiles: 3-chambered heart; 2 circuits of blood flow- *pulmocutaneous* (lungs and skin); systemic (some mixing)
 - Reptiles have septum partially dividing the one ventricle
- Mammals/Birds: 4-chambered heart; *double circulation*; complete separation between oxygen-rich and oxygen poor blood



(a) Fish



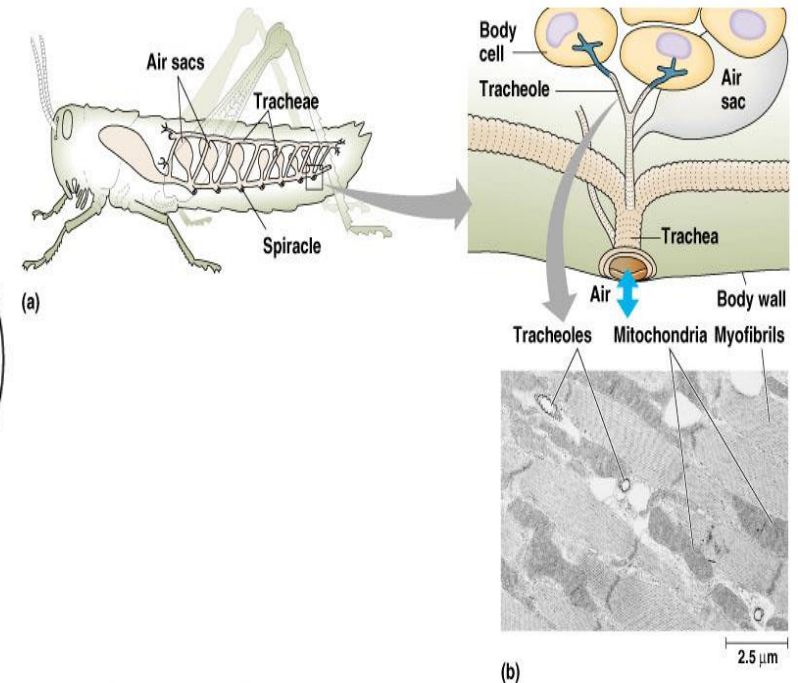
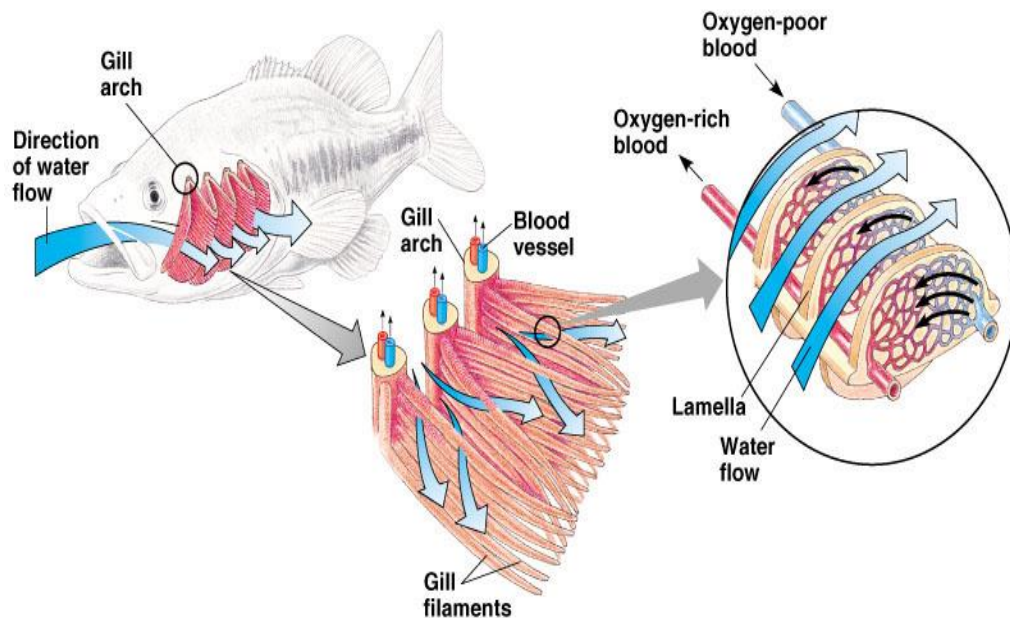
(b) Amphibian



(c) Mammal

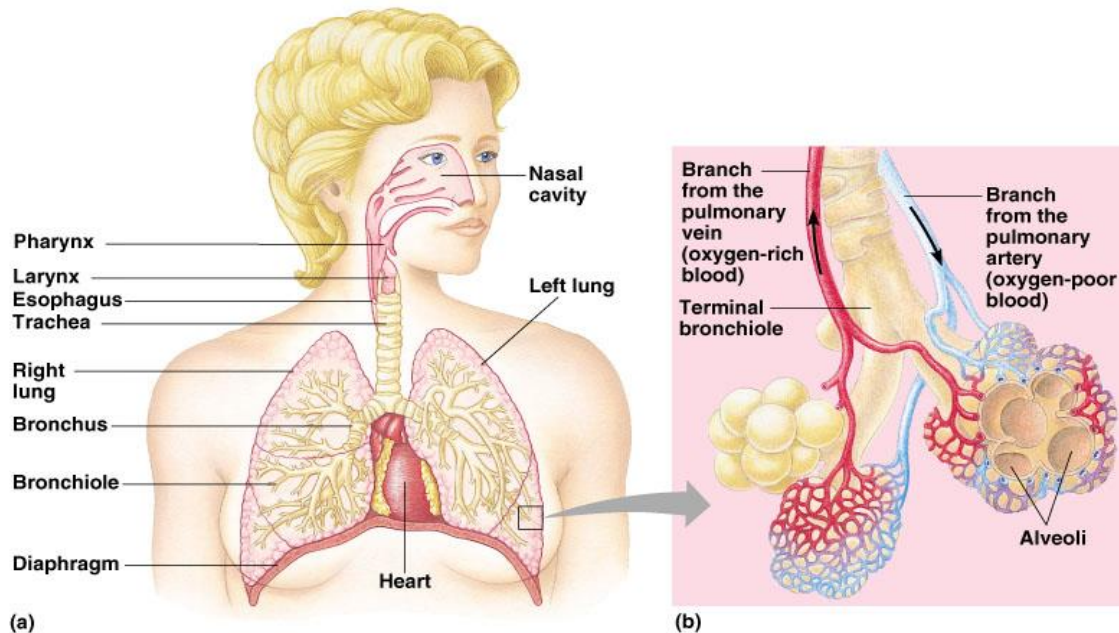
Respiratory System: Gas exchange

- Function: exchange of gas with surroundings
- Diffusion: $\text{CO}_2 \leftrightarrow \text{O}_2$ (this is not a one for one transport)
- Aquatic: Gills, Ventilation, Countercurrent exchange
- Terrestrial: Tracheal systems, Lungs



Mammalian Respiratory System

- Oral and nasal cavity
- Pharynx (throat)
- Larynx (upper part of respiratory tract)
 - Vocal cords (sound production)
- Trachea (windpipe)
- Bronchi (tube to lungs)
- Bronchioles – less cartilage and more smooth muscle
- Alveoli (air sacs)
- Diaphragm (breathing muscle)



Gas Exchange in Different Animals

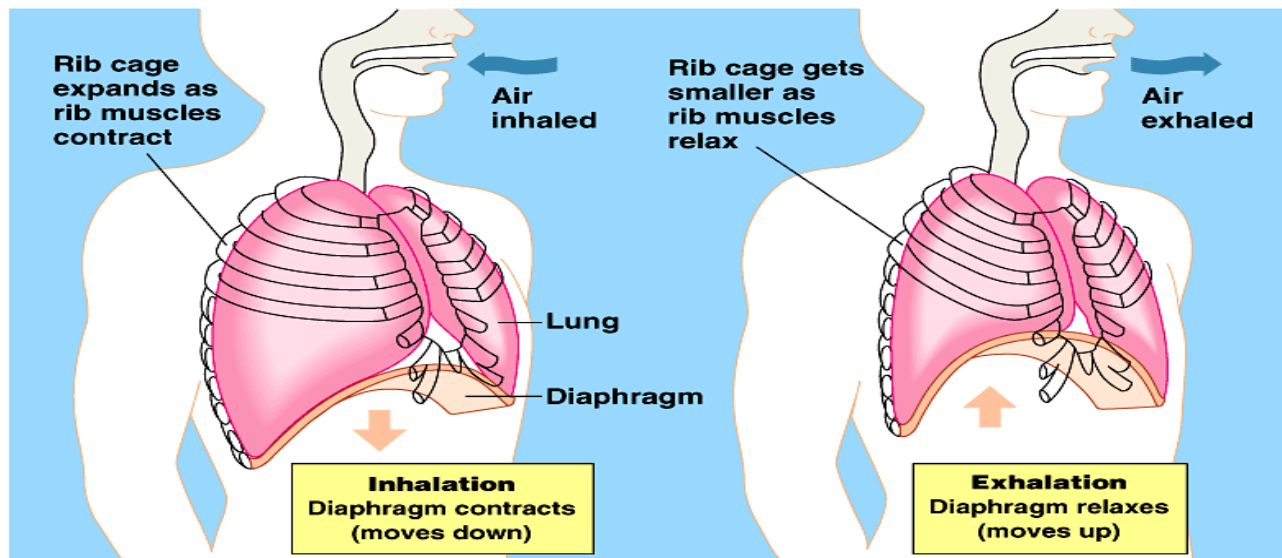
- Sponges / Hydra = over entire surface of organism
- Earthworms and Flatworms = external respiratory surface – diffusion through skin
 - O₂ carried in hemoglobin
- Grasshopper (other Arthropods and Crustaceans) = internal respiratory surface
 - Air enters through spiracles and move through tracheal tubes
 - O₂ carried in hemocyanin
- Aquatic (fish) = gills create countercurrent exchange
 - Countercurrent increases rate of diffusion into blood

Mammal Breathing

- Ventilation = movement of gases across respiratory surface
 - Partial pressure = pressure a gas exerts on a mixture of gases
 - Gas molecules move from an area of high to low partial pressure
-

Mammal Breathing

- *Inhalation*: diaphragm contraction down, increase volume, decrease pressure, air moves in
- *Exhalation*: diaphragm relaxation up, decrease volume, increase pressure, air moves out
- Regulation: CO₂ concentration detected in blood (*medulla oblongata and pons*)



Respiratory Pigments: Gas Transport

Oxygen transport-

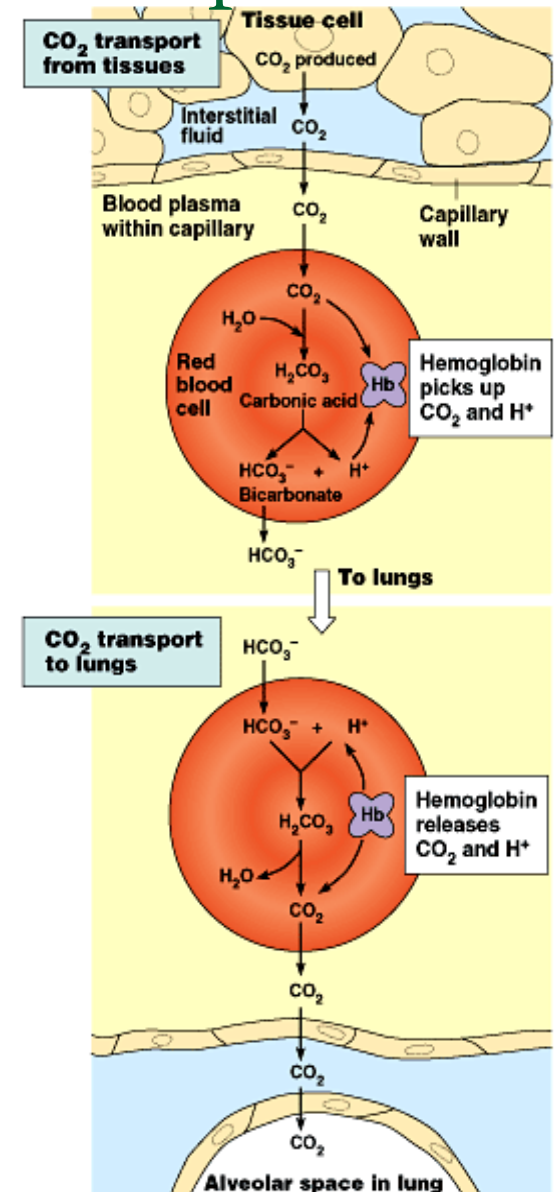
- *Hemocyanin*: found in hemolymph of arthropods and mollusks (Cu)
- *Hemoglobin*: vertebrates (Fe)

Carbon dioxide transport-

- Blood plasma (7%)
- Hemoglobin (23%)
- Bicarbonate ions (70%)

Deep-diving air-breathers-

- *Myoglobin*: oxygen storing protein



Bohr Shift Website

- <http://www.austincc.edu/emeyerth/bohr.htm>

